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XLVI.—*On a Marine Jurassic Fauna from Central Arabia.*

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[Plate XI.]

Introduction.

A collection of fossils, the determination of which forms the subject of this report, was obtained by Mr. H. St. J. B. Philby, C.I.E., from Central Arabia, during his remarkable traverse of that country in 1918 between the Persian Gulf and the Red Sea, while engaged on a Government diplomatic mission *.

These specimens, although of a fragmentary character, give interesting evidence of a marine Jurassic fauna which presents a relationship with material already described from the South-western region of Arabia.

We appear to be indebted to F. R. Mallet † for our earliest knowledge of the presence of Jurassic rocks in Arabia. This geologist discovered a certain limestone to the N. of Majhafa

* For an interesting account of his explorations of a part of this journey—with no reference, however, to geological matters—the reader is referred to Mr. Philby's paper on "Southern Najd," 'The Geographical Journal,' 1920, vol. lv. pp. 161–191, with a map of the region.

† "On the Geological Structure of the Country near Aden," Mem. Geol. Surv. India, 1871, vol. vii. pp. 257–284.

(N. of Aden) containing fossils which were submitted to Stoliczka for determination, his opinion of which was formulated in the following statement:—"The limestone is full of sections of a long turreted *Nerinea*, a species of *Cryptoplocus*; of a Pelecypod, probably a *Corbis*; and large numbers of *Spongites*, generally dichotomous. The limestone is evidently of Mesozoic age, and the few fossils appear to resemble most Upper Jurassic forms, though the same genera occur in Lower Cretaceous beds." The next account of Arabian Jurassic fossils was furnished by the late G. C. Crick and the present writer *, from a series of Molluscan remains collected by Major H. S. Hazelgrove in the districts of Nobat Dakim and Dihala, both being situated to the north of Aden. They comprised specimens of the groups Cephalopoda (*Belemnites*, *Nautilus*, *Perisphinctes*, and *Oppelia*?); Gastropoda (*Nerinea* and *Trochus*); and Pelecypoda (*Parallelodon* and *Nucula*). Our studies of this fauna enabled us to recognize affinities with that characterizing the Jurassic rocks of Somaliland (the Bihin Limestone), the Himalayas (Niti and Spiti), and Western India (Cutch). Mr. Crick was of opinion that the Cephalopods indicated a Kimeridgian age, while the other Mollusca were considered by myself as originating somewhere between the Oxfordian and Kimeridgian, and therefore belonging probably to Corallian (or Sequanian) times.

A more recently published paper by Mr. G. H. Tipper † contains a notice of some Jurassic fossils from the Aden area (Diala or Dihala region), in which he describes very similar Mollusca as referred to by G. C. Crick and myself, including *Belemnites* and different forms of *Perisphinctes*; a Gastropod of doubtful determination, some Pelecypoda of the genera *Parallelodon*, *Pinna*, *Trigonia*, *Syncyclonema*, and *Cardinia*?; and remains of *Pentacrinus* stem-joints. The author regarded this fauna as bearing "a distinctly Upper Jurassic facies."

Mr. Philby's fossils were obtained from four localities:—

(1) *Bachain*, in the neighbourhood of Sadus (long. 46°, lat. 25°), which is some 3200 feet above sea-level, where the rocks are fawn-coloured limestones of considerable hardness, being more or less siliceous, with occasional associations of "Beekite," and sometimes showing oolitic structure.

* "On some Jurassic Mollusca from Arabia," Ann. & Mag. Nat. Hist. 1908, ser. 8, vol. ii. pp. 1–29, pls. i.–iii.

† Tipper, G. H., "Notes on Upper Jurassic Fossils collected by Captain R. E. Lloyd near Aden," Records Geol. Surv. India, 1910, vol. xxxviii. pp. 336–341, pls. xxxv., xxxvi.

(2) *El Hish*, also near Sadus, is stated to be 2800 feet above sea-level. An eroded and cream-coloured example of *Isastræa*, without matrix, has been found here, so that we would be justified in assuming that its associated limestone would be of similar colour.

(3) *Ashaira* (long. 46°, lat. 22° 50′).—The fossiliferous limestone of this region is cream-coloured. This locality and the following—Hamar—are about 200 miles south of Sadus.

(4) *Hamar* (long. 46° 10′, lat. 22° 30′).—The limestone of this locality is of ferruginous colour and frequently contains minute grains of peroxide of iron; it is, besides, of great hardness, being siliceo-calcareous, and has much the appearance of a coarse sandstone.

The specimen from Quoin Island in the Persian Gulf is not organic, but is merely an example of a stalagmitic rock.

It is of interest to mention that Mr. Philby has generously presented this collection of Arabian fossils to the Geological Department of the British Museum, and that the report thereon has been drawn up at the request of the Directors of the Anglo-Persian Oil Company, Limited.

Notes on the Fossils.

Cephalopoda.

Lytoceras (?).

Under this group is included a fragmentary Ammonite represented by a matrix impression of part of a whorl bearing simple and closely-set costations. Mr. L. F. Spath, M.Sc., informs me that this specimen may belong to the genus *Lytoceras* which is widely distributed, its range extending from Liassic to Cretaceous times.

Locality. Bachain.

Gastropoda.

Nerinea, cf. *desvoidyi*, Orbigny. (Pl. XI. fig. 1.)

Nerinea desvoidyi, Orbigny, Pal. Française Terr. Jurassiques, Gasteropodes, 1850, pl. cclxi. p. 107.

Nerinea cf. *desvoidyi*, R. B. Newton, Ann. & Mag. Nat. Hist. 1908, ser. 8, vol. ii. pp. 9, 10, pl. i. fig. 10.

This form of mollusc is represented by some fragmentary natural casts of whorls, which appear to belong to two individuals and which show resemblances to the specimen previously described by me from the north of Aden. The

older whorls are of much the same dimensions, besides exhibiting a similar shape, depth, and more or less sloping sides divided by a central oblique sulcus parallel to the suture. Good published figures are available of this species, such as P. de Loriol's * examples from French Corallian rocks, as well as Thurmann and Etallon's † form of Roemer's *N. goseæ*, considered by P. de Loriol as synonymous with *N. desvoidyi*, from the older Kimeridgian (Strombian) beds of Hanoverian Germany, which combines both external and internal characters in the same specimen. The present fragments need not be confounded with the genus *Cryptoplocus*, which has a much more conically formed axis, considerably shallower volutions, and is, moreover, furnished with only a single columella plication, whereas the true *Nerinea* possesses more than one fold.

Distribution. Sequanian to Kimeridgian: Europe and Arabia.

Locality. Bachain.

Pelecypoda.

Ostrea cf. *montbeliardensis*, Contejean.

Ostrea montbeliardensis, Contejean, "Étude l'Étage Kimmeridien Montbeliard &c.," 1859 (from Mém. Soc. Emul. Doubs), p. 321, pl. xxvi. fig. 1.

The specimen consists of a single lower valve of widely suboval contour, having a flattened base, a nearly vertical outer wall which gives considerable depth to the valve, while the muscular scar-impression is antero-central. There appear to be no foliations present as in the typical form from the Kimeridgian of France, although in other characters the Arabian valve bears much resemblance to this species. Attached to the specimen are some examples of *Exogyra bruntrutana*.

Dimensions.

	mm.
Height	45
Length	38
Depth	17

Distribution. Kimeridgian: France.

Locality. Bachain.

* Mém. Soc. Linn. Normandy, 1872, vol. xvi. p. 81, pl. vi. figs. 2-5.

† 'Lethea Bruntrutana,' 1861, pl. vii. fig. 38, p. 93.

Lopha (?) *philbyi*, sp. n. (Pl. XI. figs. 2, 3.)

Description. Shell of subtriangular contour, with a well-excavated inner margin; lower valve deep, robust, ornamented with three or four principal radial costæ, from which proceed further costæ both by bifurcation and trifurcation, the inner marginal costation being of wide convexity and separated from the others by a very deep and broad furrow resembling a lobe. The costæ are prominent, swollen, and divided by moderately deep furrows, while the whole surface is of lamellose structure. The interior exhibits a triangular ligamental area and a fairly large reniform muscular impression, which is closer to the inner than the outer margin and not far from the basal line. Only a mere isolated fragment of the presumably upper valve is present in the collection, showing a partial internal view, the outer surface being buried in an intensely hard matrix, thus hiding up external features. This fragment seems to indicate that the upper valve was of flattened character, and might have had some radial ribs, which would suggest that the oyster belonged to Bolten's genus *Lopha*, which is equivalent to Fischer de Waldheim's *Alectryonia* of a later date. There are several fragmentary examples of this shell in a reddish-brown siliceo-calcareous limestone with minute, rounded, ferruginous grains. It shows a resemblance to Cretaceous forms such as *Ostrea devillei*, Coquand, from France, and to Blanckenhorn's *O. dieneri* from the Cenomanian of Syria; but neither of those species, however, is furnished with what may be termed the inner costal lobe, which distinguishes the present shell.

Dimensions.

Largest lower valve:	mm.
Height	45
Length	50
Diameter	25

Locality. Hamar.

Lopha solitaria (J. de C. Sowerby).
(Pl. XI. figs. 4, 5.)

Ostrea solitaria, J. de C. Sowerby, Min. Conch. 1824, vol. v. pl. 468. figs. 1, p. 105.

It is interesting to be able to recognize so well-known a European species as *Lopha solitaria* among the Arabian fossils. The specimen consists of a well-preserved upper

valve of evidently a young form, with a depressed oblong summit-region, an excavated inner lateral margin, and a basal region of considerable width. Some fourteen or fifteen prominent costæ are present, divided by wide, deep, and angulate furrows, the costæ being more or less vertical at first, but afterwards dichotomizing and pursuing a radial course to the lateral and ventral regions, forming V-shaped angulations in front. Fine concentric vertical growth-laminations cover the surface of the valve.

Dimensions.

	mm.
Height	32
Length	28
Diameter	9

Distribution. Sequanian to Kimeridgian: Britain and Europe.

Locality. Ashaira.

Gryphæa cf. *dilatata*, J. Sowerby.

Gryphæa dilatata, J. Sowerby, Mineral Conchology, 1816, vol. ii. pl. cxlix. fig. 1, p. 113.

Specimen represented by a moderate-sized, hemispherical, lower valve of the genus *Gryphæa*, which is apparently related to J. Sowerby's *G. dilatata*. It is of rounded contour with a well-excavated lateral lobe, while the surface bears several more or less distant concentric growth-furrows. As the specimen is attached to its matrix, all internal characters are hidden, besides which the margins are a good deal fractured.

Dimensions.

	mm.
Height	35
Length	43

Distribution. Callovian to Sequanian: Britain and Europe.

Locality. Bachain.

Exogyra bruntrutana (Thurmann, P. de Loriol). (Pl. XI. fig. 6.)

Ostrea bruntrutana (Thurmann), P. de Loriol, Mém. Soc. Linn. Normandie, 1872, vol. xvi. p. 399, pl. xxiv. figs. 7–18.

Exogyra imbricata, H. Douvillé, Bull. Soc. Géol. France, 1886, sér. 3, vol. xiv. pl. xii. figs. 8, 9, pp. 230–232 (non Krauss); Müller, Born-

hardt's Deutsch-Ost-Afrika, 1900, vol. vii. pp. 532, 533, pl. xviii figs. 11, 12.

Exogyra bruntrutana, Futterer, Zeitsch. Deutsch. Geol. Ges. 1897, vol. xlix. pp. 582, 583, pl. xix. fig. 1; Dacqué, Beitr. Pal. Geol. Ost-ungarns Orients, 1905, vol. xvii. pp. 135, 136, pl. xv. (2) fig. 18.

Several examples of this small (15 × 11 mm.) species occur in a limestone matrix, while others are attached to a shallow, rounded, ostreiform lower valve from the same beds which has the appearance of being closely related to *O. montbeliardensis* of Contejean from the Kimeridgian of France.

Distribution. Oxfordian to Portlandian: Europe and Africa (Shoa, Somaliland, and near Kiswere, E. Africa).

Locality. Bachain.

Chlamys articulatus (Schlotheim).
(Pl. XI. fig. 7.)

Pectinites articulatus, Schlotheim, Die Petrefactenkunde, 1820, p. 227.
Pecten articulatus, Goldfuss, Petref. Germaniæ, 1833, vol. ii. p. 47, pl. xc. fig. 10.

This determination includes the remains of a single valve embedded in matrix, showing no hinge-expansions, the margins likewise, except at the base, being also absent. The few costæ preserved bear a resemblance to those seen in Schlotheim's *P. articulatus*, as first figured by Goldfuss from the "Korallenkalk" of Nattheim, Germany, although the actual type came from the Jurassic Limestone of Aarau in Switzerland. The costæ are acutely lamellated at more or less equal distances, and so producing an infundibuliform character, besides which the furrows are observed to be covered with a series of closely-set, oblique, transverse striations. This species is related to *P. vimineus* of J. de C. Sowerby, which ranges from Bajocian to Oxfordian times, and which appears to have fewer costæ, a more elongate contour, while the furrow-striations are more horizontal than oblique. Schlotheim's type from Aarau is now regarded as belonging to the Uppermost Sequanian (=Astartian stage), whereas Goldfuss's example from Nattheim is referred to the Kimeridgian deposits. An English specimen has been recognized from the Cornbrash.

Distribution. Bathonian to Kimeridgian: Britain and Europe.

Locality. Ashaira.

Hinnites cf. *inæquistriatus* (Voltz), Thurmann.
(Pl. XI. fig. 8.)

Hinnites inæquistriatus, Voltz, in Thurmann (list name only), Mém. Soc. Hist. Nat. Strasbourg, 1833, vol. i. part 2, p. 13; Thurmann and Etallon, Lethea Bruntrutana, 1862, pl. xxxvii. fig. 13, p. 267.
Hinnites (*Pleuronectites*) *inæquistriatus*, Futterer, Zeitsch. Deutsch. Geol. Ges. 1897, vol. xlix. pp. 588, 589, pl. xix. figs. 6, 7.

This specimen is quite fragmentary, with fractured margins throughout. It consists of part of the interior of an upper valve embedded in matrix in which can be traced four or five distant radial costæ with subsidiary and weaker ones between, the whole being crossed by occasional concentric growth-lines. As the specimen exhibits only internal characters, it is impossible to surmise any details of the outer ornamentation of the principal ribs, such structure in the type being composed of more or less distant recurring tubular spiniform growths. Speaking generally, the Arabian fossil shows considerable resemblance to Futterer's interpretation of Thurmann and Etallon's original figure of this shell.

Distribution. The species has been recognized from Sequanian and Kimeridgian rocks, the original specimen having been described from the Kimeridgian (Strombian) of Porrentruy, Switzerland, whereas the example referred to by Futterer was obtained from a similar horizon at Shoa, Southern Abyssinia.

Locality. Bachain.

Brachiopoda.

Terebratula subsella, Leymerie.
(Pl. XI. figs. 9, 10.)

Terebratula subsella, Leymerie, Statistique Géol. Mineral Dep. de l'Aube, 1846, pp. 224, 248, pl. x. fig. 5; H. Douvillé, Bull. Soc. Géol. France, 1886, sér. 3, vol. xiv. p. 232, pl. xii. fig. 2.
Terebratula suprajurensis, Futterer, Zeitsch. Deutsch. Geol. Ges. 1897, vol. xlix. p. 617.
Terebratula subsella, Dacqué, Beitr. Pal. Geol. Osterr.-Ungarns Orients, 1905, vol. xvii. p. 129, pl. xiv. figs. 5, 6, and pl. xvii. fig. 6.

This well-known Upper Jurassic species is represented by a small example ($18 \times 16 \times 12$ mm.) with both valves in closed association. It has been recognized from Abyssinia (Shoa) by Douvillé and Futterer, and by Dacqué from Somaliland. Both Davidson and J. F. Walker have referred to its occurrence in British Corallian (Sequanian) rocks.

Distribution. Upper Sequanian (Astartian) to the Kimeridgian : Britain, Europe, and Africa (Shoa and Somaliland).
Locality. Bachain.

Rhynchonella sp. (Pl. XI. fig. 11.)

This form appears to come nearest to Dacqué's * *R.* sp. ind. 1 from the Sequanian (=Malm) of Somaliland. It is attached by the ventral or pedicle valve to a hard limestone-matrix, so that only the dorsal or brachial valve is exposed, with a part of the projecting beak of the opposing valve. The deltidial characters are much obscured, although the foramen appears to be well above the umbonal line. There are rather more than twenty acute costæ present, whilst the measurements of the valve are similar in width and length, viz. 23 mm. The shell evidently belongs to the type of *R. obsoleta* of J. Sowerby † from the British Bathonian, as alluded to by Dacqué in his Somaliland memoir. The Arabian specimen shows also a considerable resemblance to H. Douvillé's ‡ interpretation of *R. edwardsi* of Chapuis and Dewalque §, from the Shoa limestones of Abyssinia, a shell originally described from the French Bathonian, and which the present writer thinks is distinct from that depicted by Douvillé's figures.
Locality. Bachain.

Rhynchonella cf. *subvariabilis*, Davidson.

Rhynchonella subvariabilis, Davidson, Mon. Pal. Soc. 1852, vol. i. (British Oolitic Brachiopoda), pp. 80, 81, pl. xv. fig. 7, and pl. xviii. fig. 11.

This form of Brachiopod is represented by a single specimen with closed valves, which from its structural details appears to show affinities with Davidson's *R. subvariabilis* from the British Kimeridgian. Each valve possesses about twelve well-sculptured costæ with sharp and elevated summits ; the pedicle-valve is depressed in the centre, but projecting laterally, while the brachial valve is very convex, although abruptly sloping at the sides and exhibiting an elevated

* Dacqué, Beitr. Pal. Geol. Ost.-Ungarns Orients, 1905, vol. xvii. pp. 127, 128, pl. xiv. fig. 11.
† Sowerby, Min. Conchology, 1815, vol. i. pl. lxxxiii. figs. 7, 8, p. 192.
‡ Douvillé (H.), Bull. Soc. Géol. France, 1886, sér. 3, vol. xiv. p. 236, pl. xii. fig. 5.
§ Chapuis and Dewalque, Mém. Cour. Acad. R. Belgique, 1853, vol. xxv. pl. xxxvii. fig. 9, p. 255.

mesial region composed of three plaits. The foramen is of moderate size, while the beak is not much produced. The specimen is entirely free from matrix.

Dimensions.

	mm.
Height	16
Width	17
Diameter	11

Distribution. Kimeridgian: Britain, and Portlandian: France.

Locality. Hamar.

Polyzoa.

Stomatopora cf. *waltoni*, Haime. (Pl. XI. fig. 12.)

Stomatopora waltoni, Haime, Mém. Soc. Géol. France, 1854, sér. 2, vol. v. p. 162, pl. vi. fig. 3; J. W. Gregory, Cat. Jurassic Bryozoa British Museum, 1896, pl. i. fig. 5, pp. 54, 55.

I am indebted to Dr. W. D. Lang for the identification of this little fossil (10 × 8 mm.), which is adherent to the internal surface of a fragmentary indeterminable shell. It represents a delicately branching organism exhibiting dichotomy, while all the branches are furnished with equidistant minute apertures. Good figures of the typical form, from the Bradford Clay of England, were published by Haime, since which the excellent figures and description of Prof. J. W. Gregory should be consulted for the latest knowledge of this species. According to Eastman's 'Zittel'*, the genus *Stomatopora* ranges from Ordovician to Recent times.

Distribution. Bathonian of Britain and France.

Locality. Bachain.

Echinodermata.

Pygurus (?).

A single specimen representing a fragment of test embedded in matrix belonging to the upper surface, in which part of the basal margin is preserved. There is also seen part of an elongately petaloid ambulacral area, the poriferous zones, and wide interambulacral regions. So far as can be judged from so imperfect a fossil, it appears to be related to

* 'Text-book of Paleontology,' 1913, vol. i. p. 319.

such a form as *Pygurus costatus*, Wright, from British Corallian rocks. I am obliged to Dr. F. A. Bather, F.R.S., for suggesting the reference of this specimen to the genus *Pygurus*, which is characteristic of Jurassic seas, although occurring as well in Cretaceous times.

Locality. Bachain.

Rhabdocidaris sp. (Pl. XI. fig. 13.)

This determination, kindly confirmed by Dr. F. A. Bather, refers to a well-preserved fragmentary spine belonging to Desor's *Rhabdocidaris*—a genus which is particularly characteristic of Upper Jurassic deposits, although recognized also from older Cretaceous rocks. This spine is of trilateral form and bears a central longitudinal ridge on one of its faces, whilst the other surface is much depressed but furnished also with a median ridge of a more rudimentary type. The lateral margins are equidistantly spined, the ridge-summit is tubercled, while the remainder of the surface is covered with closely set, longitudinal, microscopical striations composed of minute beaded tubercles of varying dimensions. The specimen appears to be related to *R. orbignyana*, Agassiz *, from the Kimeridgian of Europe (Nattheim, &c.).

Locality. Bachain.

Actinozoa (Corals).

Montlivaltia sp.

A small and simple turbinate coral, possessing a rounded calyx full of closely arranged radial septa; the central structure of the cup is obscured by a hard matrix. Numerous dissepiments are observable between the septa in the calycular region as well as longitudinally, where the epithecal covering has been partially dissolved away during fossilization, thus exposing the septal structure. In places the epitheca is coated with "Beekite." *Montlivaltia* is a well-known Jurassic genus, although the specimen requires more study and should also be sectioned before its relationships are ascertainable with described species. At present the specimen is suggestive of an Upper Jurassic age, between the Sequanian and Kimeridgian.

* See Desor, 'Synopsis des Echinides Fossiles,' 1858, p. 40, pl. viii. figs. 7–9.

Dimensions.

	mm.
Diameter of calyx	20
Height of corallum	40

Locality. Bachain.

Isastrea sp.

This determination refers to a fairly large, rounded, and elevated corallum composed of unequally sized calyces, which in the neighbourhood of the margin frequently merge into one another and form elongate furrows, as characterizes the genus *Latomeandra*. There is, however, no epitheca in that genus, whilst the base of the Arabian fossil is distinctly furnished with a concentric epithecal growth. Through considerable erosion the septal characters are much obscured, so that until the specimen has been sectioned for microscopical examination it is impossible to give more details of its structure.

Dimensions.

	mm.
Height	45
Diameter	90

Locality. Al Hish.

Spongiæ.

Lymnorella sp.

This fossil is of subspherical contour, with the basal region filled with matrix. The surface-structure consists entirely of microscopical apertures, varying in size and presenting a minute vermicular type of structure such as is present in Lamaroux's genus *Lymnorea*, now known as *Lymnorella* of Hinde, on account of the preoccupation of the first-mentioned name. The genus is very characteristic of Jurassic rocks.

Dimensions.

	mm.
Height	25
Diameter	30

Locality. Bachain.

Summary.

The fossils herewith described represent the remnants of a marine fauna which thrived over a considerable area of what is now Arabia during the Jurassic period. They were chiefly obtained from Bachain, only two determinable specimens having been found at Hamar and two at Ashaira, while one

came from El Hish. The appended "Chart" (p. 402) will serve to show the elements of this fauna and its distribution, both geological and geographical.

Some of the specimens, although mostly imperfect, have exhibited structures that have allowed of a fairly close determination, and it is certain that they may be recognized as belonging to the Sequanian and Kimeridgian stages of Upper Jurassic times. *Exogyra bruntrutana*, however, occurs also in the Portlandian, although originating in the Oxfordian, whereas *Chlamys articulatus* ranges from Bathonian to the Kimeridgian, and the Polyzoan is apparently only known in the Bathonian stage. The *Nerinea* has already been noticed as occurring in Upper Jurassic rocks north of Aden, the Bachain fragments of this genus being associated with equally well-known fossils that present the Sequanian–Kimeridgian facies.

It is interesting to note a faunistic resemblance with Upper Jurassic fossils of Somaliland and Abyssinia, described respectively by Dacqué * and Futterer †, and which also extends to European and British faunas of the same period. For the present, therefore, this fauna may be regarded as of Sequanian (=Corallian)–Kimeridgian age, although it is hoped that future explorations will yield a greater variety of better-preserved and more abundant specimens, and so enable us to gather further information on Arabian Jurassic stratigraphy.

Finally, congratulations are due to Mr. Philby on his obtaining these relics of a marine fauna from an entirely new region of Arabia, and therefore materially increasing our knowledge as to the extent of those marine conditions which prevailed over so great an area of that country during the Jurassic period.

EXPLANATION OF PLATE XI.

Nerinea cf. *desvoidyi*, Orbigny.

Fig. 1. Natural cast of two of the older volutions, showing the median groove.

Lopha (?) *philbyi*, sp. n.

Fig. 2. External view of a lower valve, showing the divided radial

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* "Beiträge zur Geologie des Somalilandes-Oberer Jura," Beitr. Pal. Geol. Osterr.-Ungarns Orients, 1905, vol. xvii. pp. 119–159, pls. xiv.–xviii.

† "Beiträge zur Kenntniss des Jura in Ost-Afrika: Der Jura von Schoa (Sud-Abessinien)," Zeitsch. Deutsch. Geol. Ges. 1897, vol. xlix. pp. 568–627, pls. xix.–xxii.

Chart of the Fauna.

Generic and Specific Determinations.	Arabia.				Jurassic Stages above the Lias.							Geographical Distribution.				
	Bachain.	El Hish.	Hamar.	Ashaira.	Bajocian.	Bathonian.	Callovian.	Oxfordian.	Sequanian.	Kimeridgian.	Portlandian.	Arabia.	Somaliland.	Abyssinia.	Europe.	Britain.
Cephalopoda.																
Lytoceras (?)	*															
Gastropoda.																
Nerinea cf. *desvoidyi*, Orb.	*	...	...	...	...	...	...	...	*	*	...	*	...	...	*	
Pelecypoda.																
Ostrea cf. *montbeliardensis*, Contej.	*	...	...	...	...	...	...	..	...	*	...	...	...	...	*	
Gryphæa cf. *dilatata*, J. Sowerby	*	...	...	...	...	...	*	*	*	...	...	...	...	...	*	*
Exogyra bruntrutana, Loriol	*	...	...	...	...	...	...	*	*	*	*	...	*	*	*	
Lopha (?) *philbyi*, sp. n.	...	...	*													
Lopha solitaria, J. de C. Sowerby	...	...	...	*	...	...	...	...	*	*	...	...	...	...	*	*
Hinnites cf. *inæquistriatus*, T. & E.	*	...	...	...	...	...	...	...	*	*	...	...	...	*	*	
Chlamys articulatus (Schloth.)	...	...	...	*	...	*	*	*	*	*	...	...	...	...	*	*
Brachiopoda.																
Terebratula subsella, Leym.	*	...	...	...	...	...	...	...	*	*	...	...	*	*	*	*
Rhynchonella sp.	*															
Rhynchonella cf. *subvariabilis*, Dav.	...	...	*	...	...	...	...	...	...	*	*	...	...	...	*	*
Polyzoa.																
Stomatopora cf. *waltoni*, Haime	*	...	...	...	...	*	...	...	...	...	...	...	...	...	*	*
Echinoidea.																
Pygurus (?)	*															
Rhabdocidaris sp.	*															
Actinozoa [=Corals].																
Montlivaltia sp.	*															
Isastræa sp.	...	*														
Spongiæ.																
Lymnorella sp.	*															

costæ and the widely convex lobe-like rib in front separated by a broad and deep furrow.

Fig. 3. Internal surface of a similar valve, but belonging to another individual, showing a wide ligament area and the reniform muscular scar.

Lopha solitaria (J. de C. Sowerby).

Fig. 4. A young form of this species showing a narrow oblong summit-region, a widened base, and a series of deeply angulate divergent ribs.

Fig. 5. Front margin of the same specimen, showing the prominent angulations, which receive the interlocking parts of the opposing valve.

Exogyra bruntrutana (Thurmann, P. de Loriol).

Fig. 6. Valve-interiors embedded in matrix.

Chlamys articulatus (Schlotheim).

Fig. 7. External view of a fragmentary valve, showing the lamellated character of the costæ.

Hinnites cf. *inæquistriatus* (Voltz), Thurmann.

Fig. 8. Representing part of an upper valve taken from a plasticine cast of a natural cavity in matrix, showing strong distant costæ and intermediate subsidiary ribbing.

Terebratula subsella, Leymerie.

Fig. 9. Showing a large foramen lying close to the umbone of the dorsal valve, and the biplicated base.

Fig. 10. Different view of the same specimen, exhibiting the biplicated base of the dorsal valve, placed uppermost in the figure.

Rhynchonella sp.

Fig. 11. Shows dorsal valve chiefly, the other being hidden in matrix with the exception of the narrow lateral surface of the beak. Numerous ribs are present.

Stomatopora cf. *waltoni*, Haime.

Fig. 12. Showing dichotomizing branches and minute equidistant apertures. × 3.

Rhabdocidaris sp.

Fig. 13. Showing the trilateral form of this spine, with its marginal dentations, the median ridge, and the minutely beaded surface.

Note.—Figures of the natural size, with the exception of fig. 12, which is magnified three diameters.